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(58) Field of Search
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(54) Abstract Title
Shaping blocks of material on a drum

(57) Apparatus for shaping blocks 3 of formable material (e.g. frozen foodstuff) comprises a rotatable drum carrying at least two outwardly facing cavities 2 therearound, a drive 10, 11, 13, 14, 20 for rotating the drum 1 from a loading position to a discharge position and a magazine 4 of blocks 3 of material in a stack at the loading position. Displacement means 5 shifts a block 3 from the stack into a cavity 2 as it registers with magazine 4 drum 1 rotates. Thrust means 6 with force derived from a linkage 8 forces the block 3 into the cavity 2 to shape it as drum 1 rotates towards the discharge position where collection means 16 receives the shaped block. With rotation of the drum, relative movement between linkage 8 and drum 1 causes thrust member 6 to be moved into and out of the cavity 2. The apparatus can be situated in a temperature controlled enclosure. The drum drive may be programmable whereby the speed of drum rotation is altered during each rotation. Fluid such as water may be sprayed onto some or all of the blocks, the cavities and the thrust member.

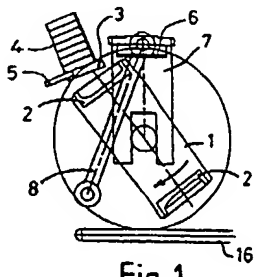
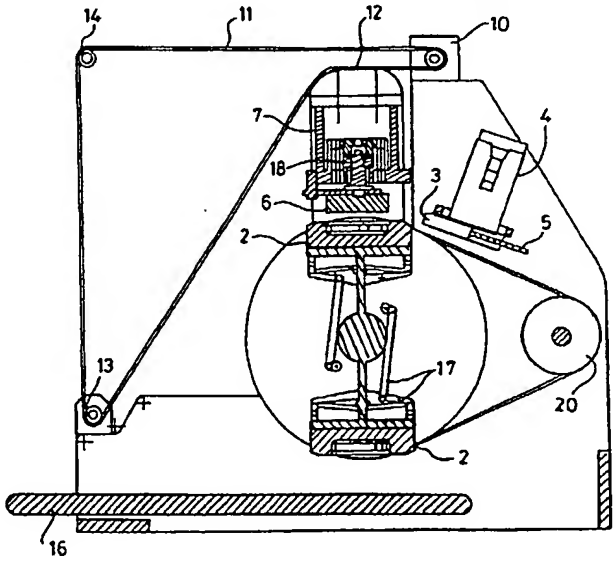


Fig. 1



A-A

Fig. 16

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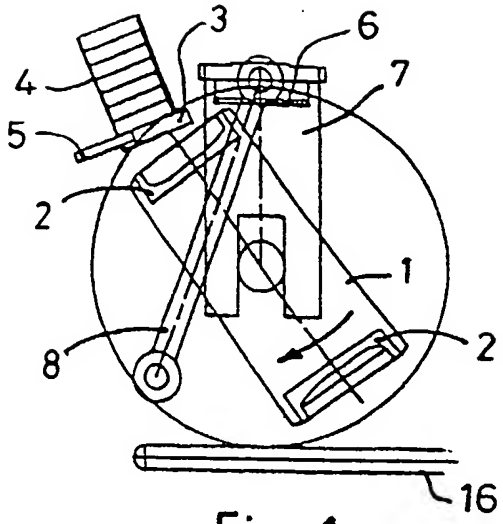


Fig. 1

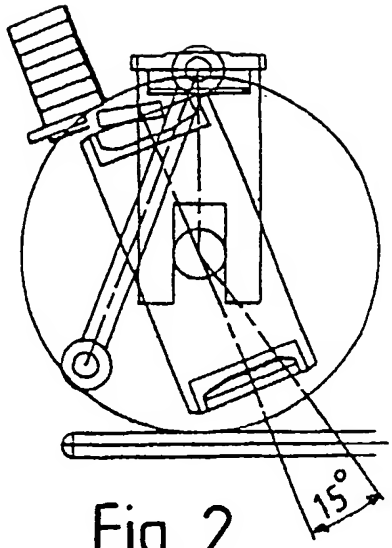


Fig. 2

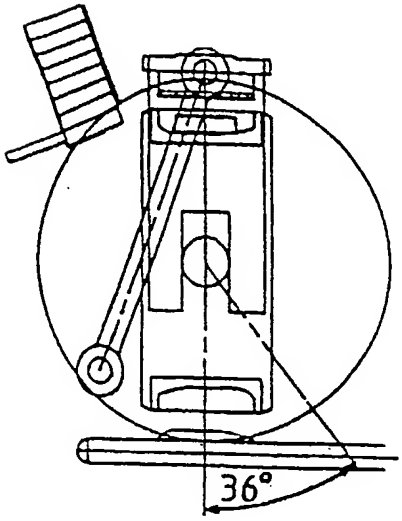


Fig. 3

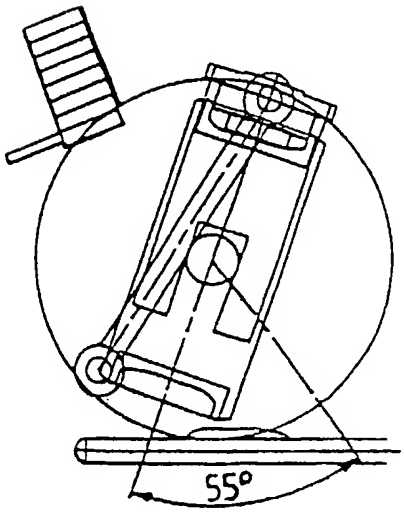


Fig. 4

SEQUENCE DIAGRAM I (1)

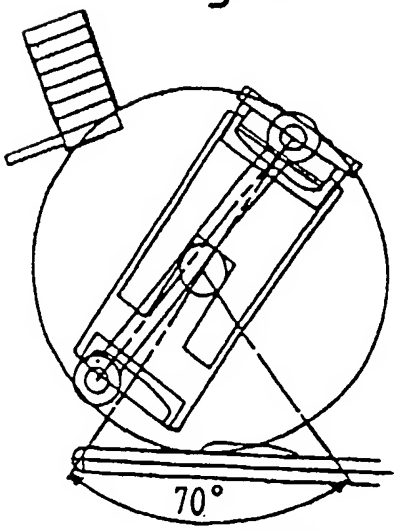


Fig. 5

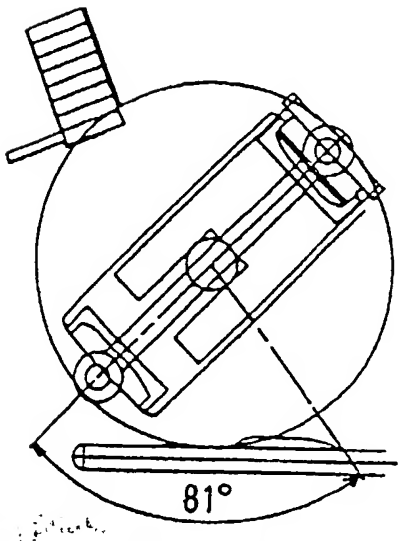


Fig. 6

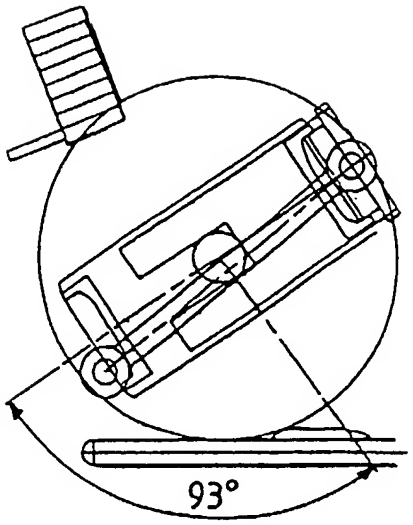


Fig. 7

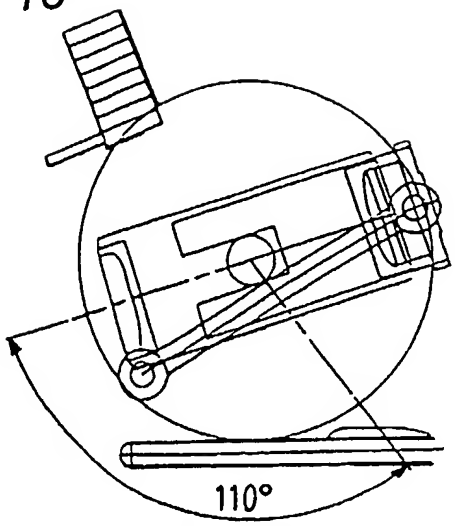


Fig. 8

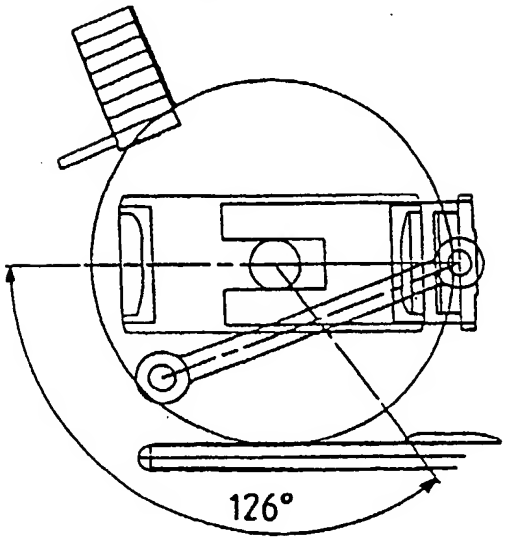


Fig. 9

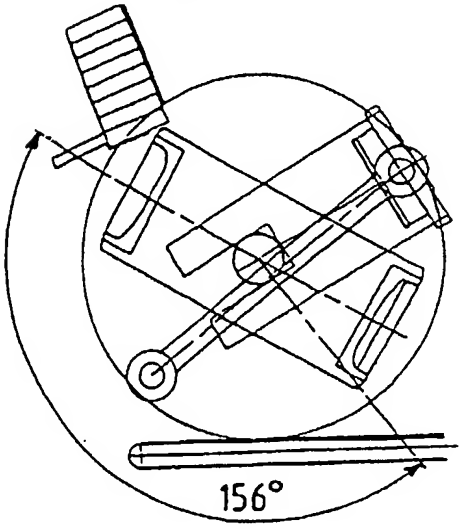


Fig. 10

SEQUENCE DIAGRAM I (2)

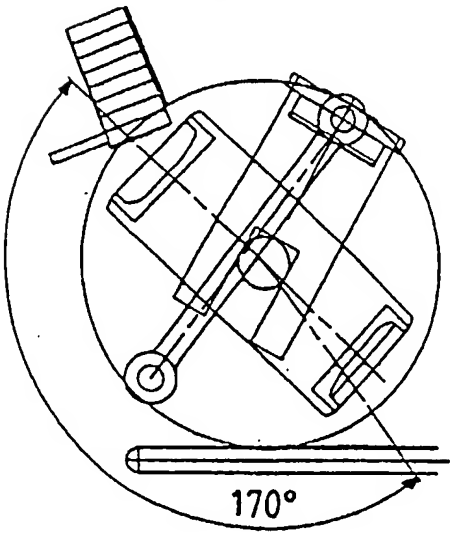


Fig. 11

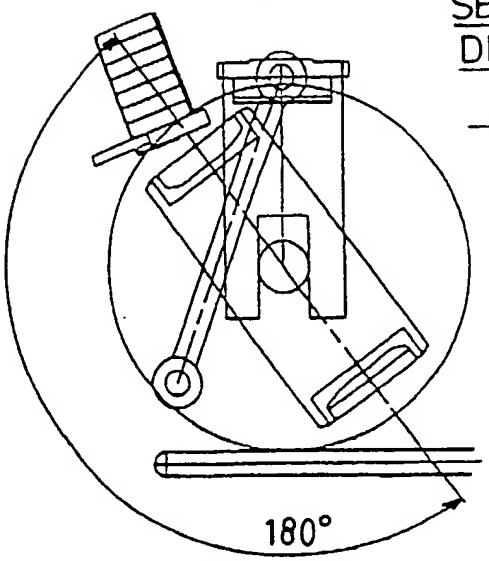
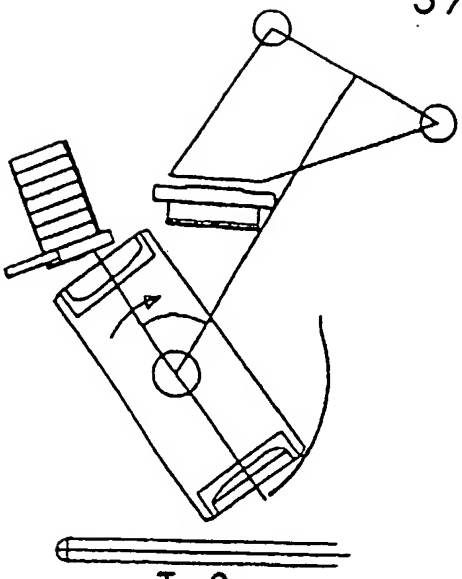


Fig. 12



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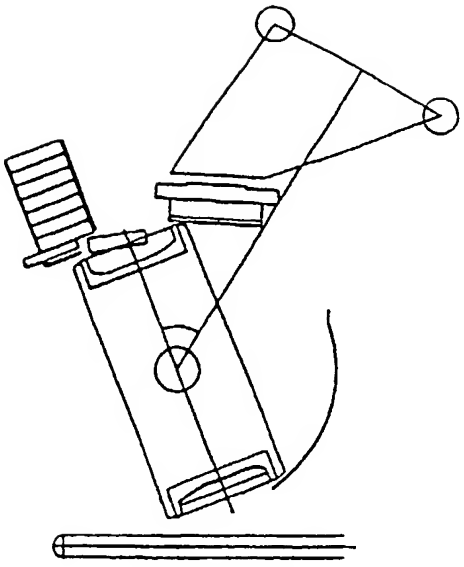
(TIMES ARE FOR 12rpm)



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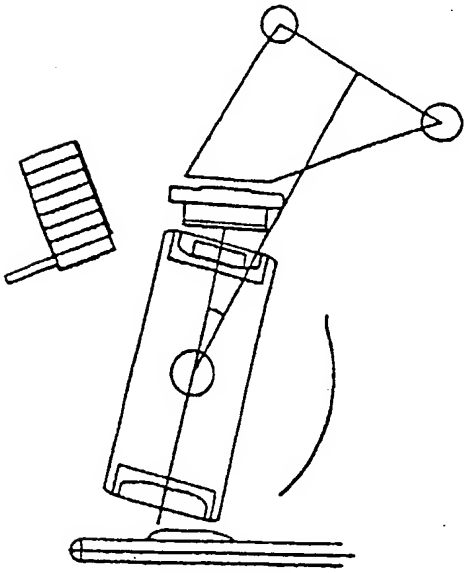

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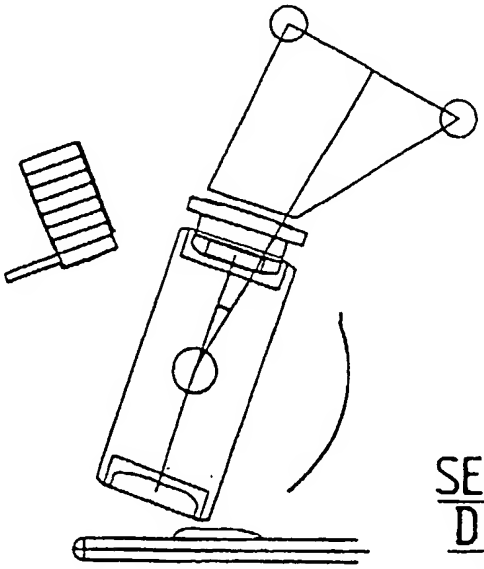

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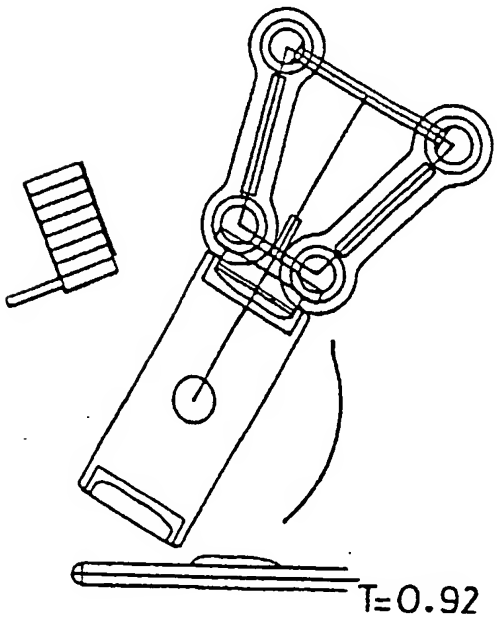

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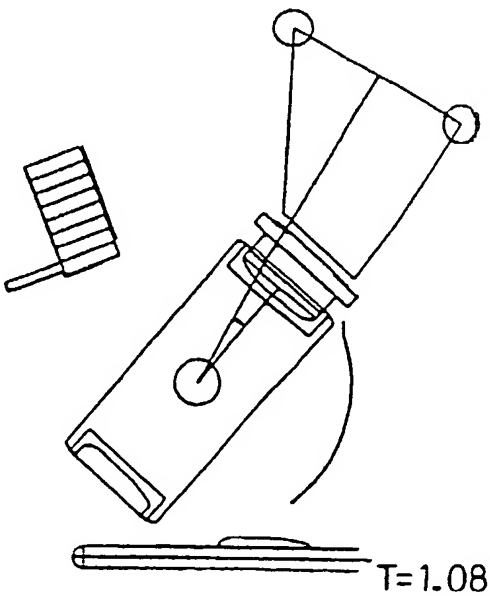

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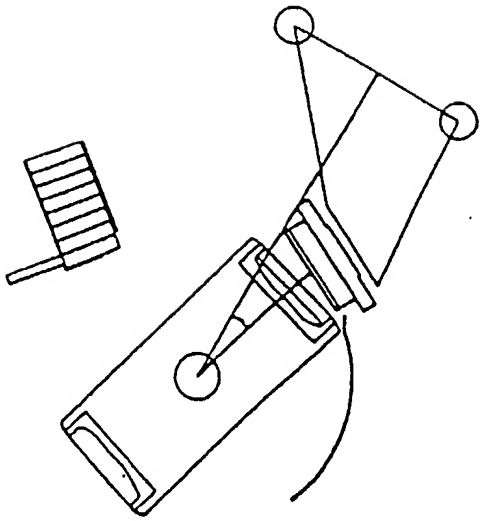

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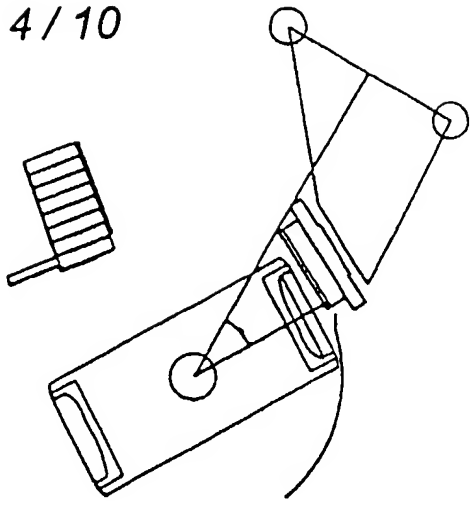

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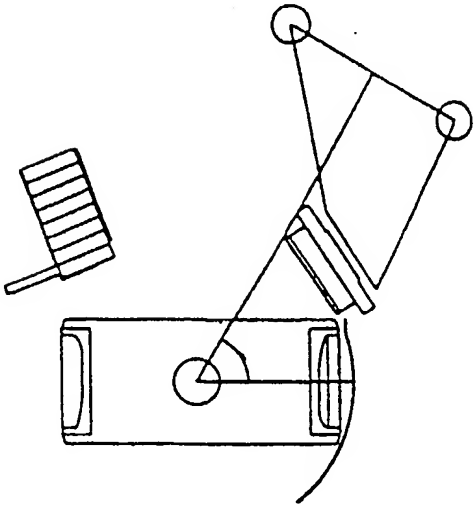

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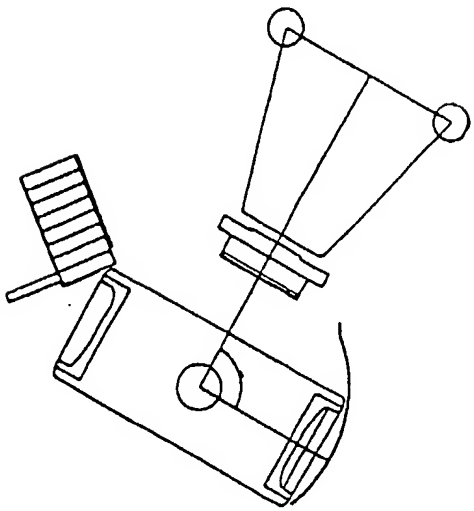

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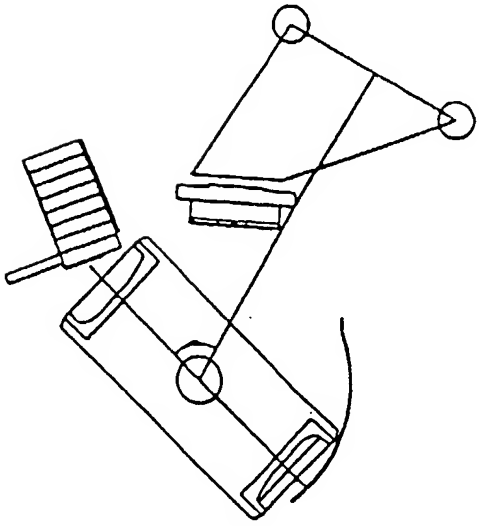

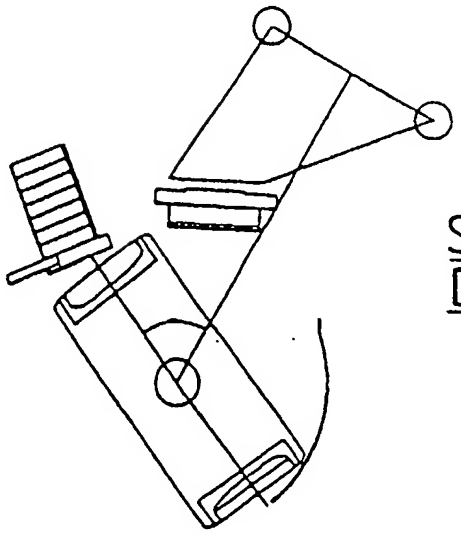

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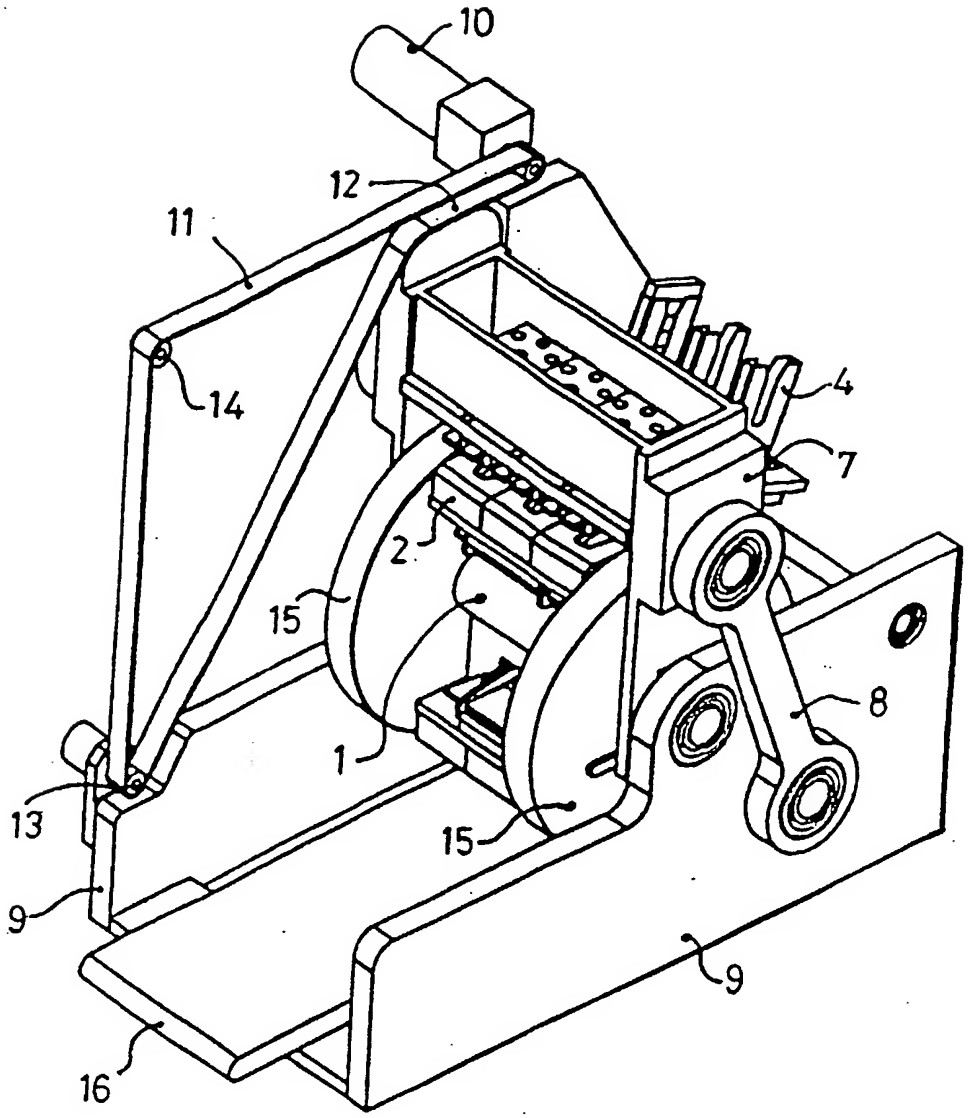


Fig. 13

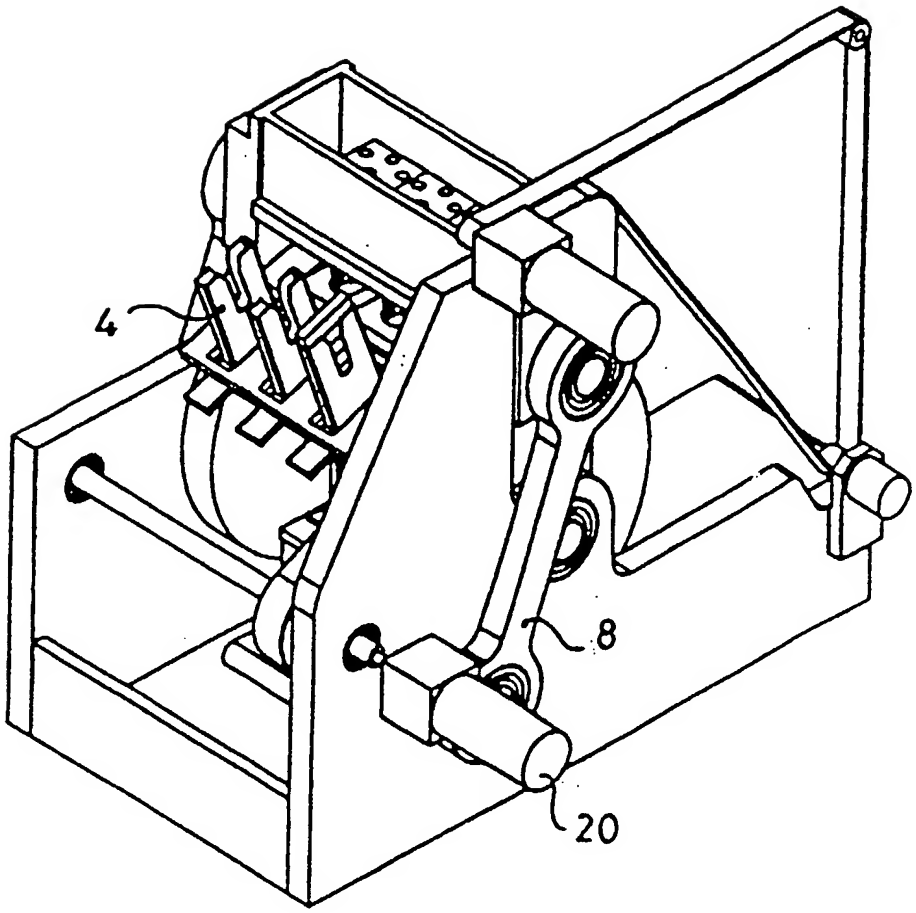


Fig. 14

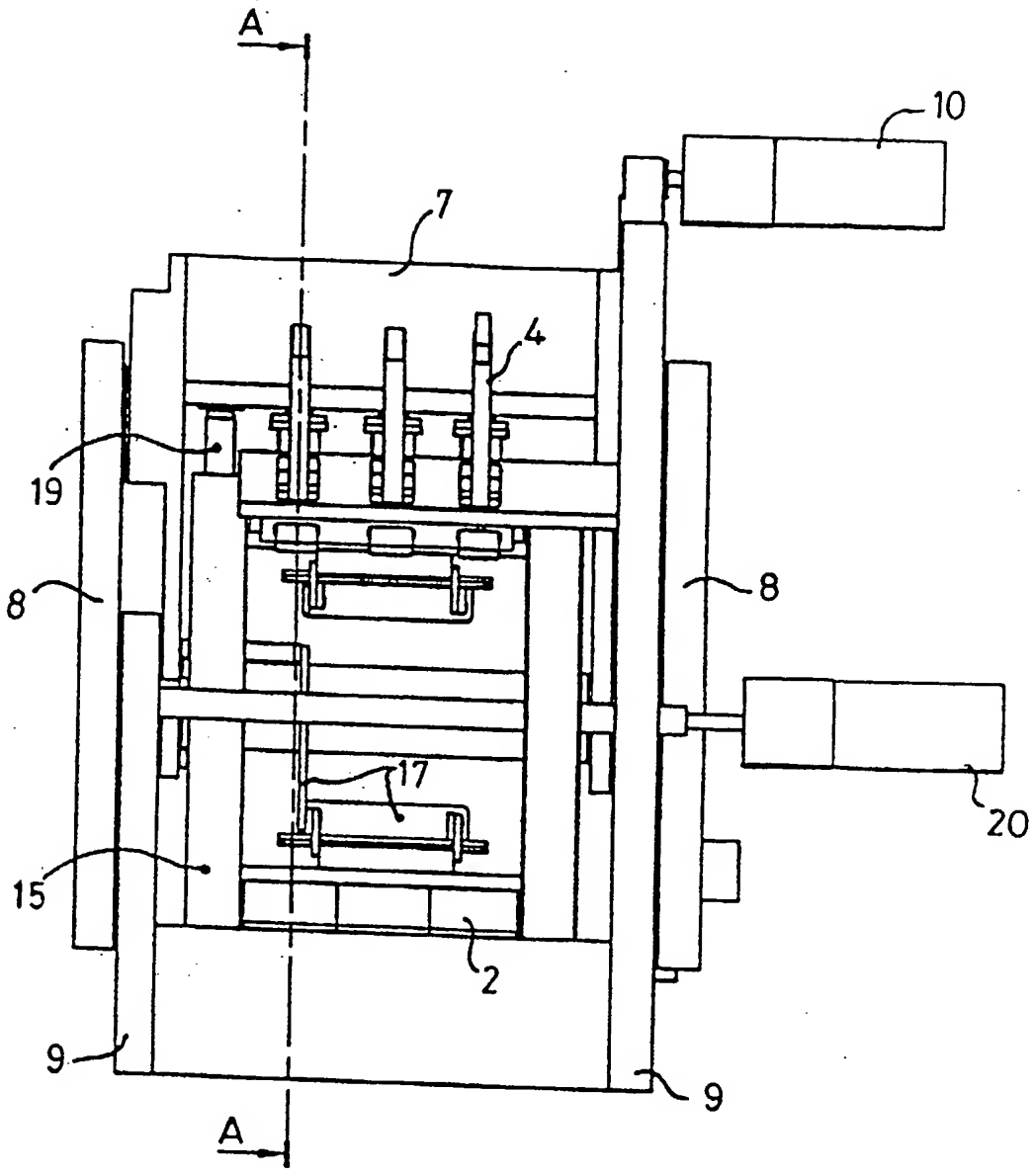
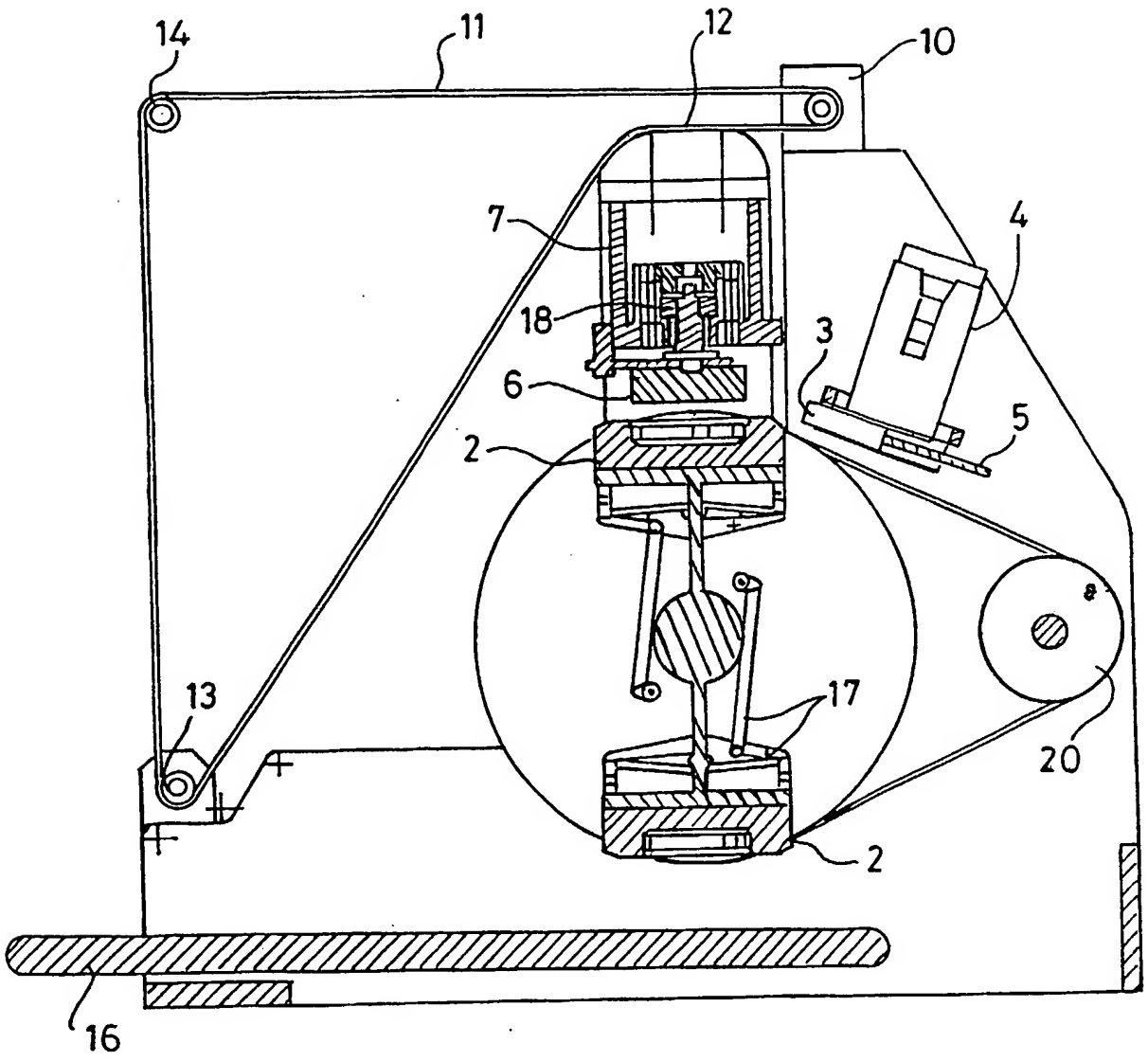


Fig. 15



A – A

Fig. 16

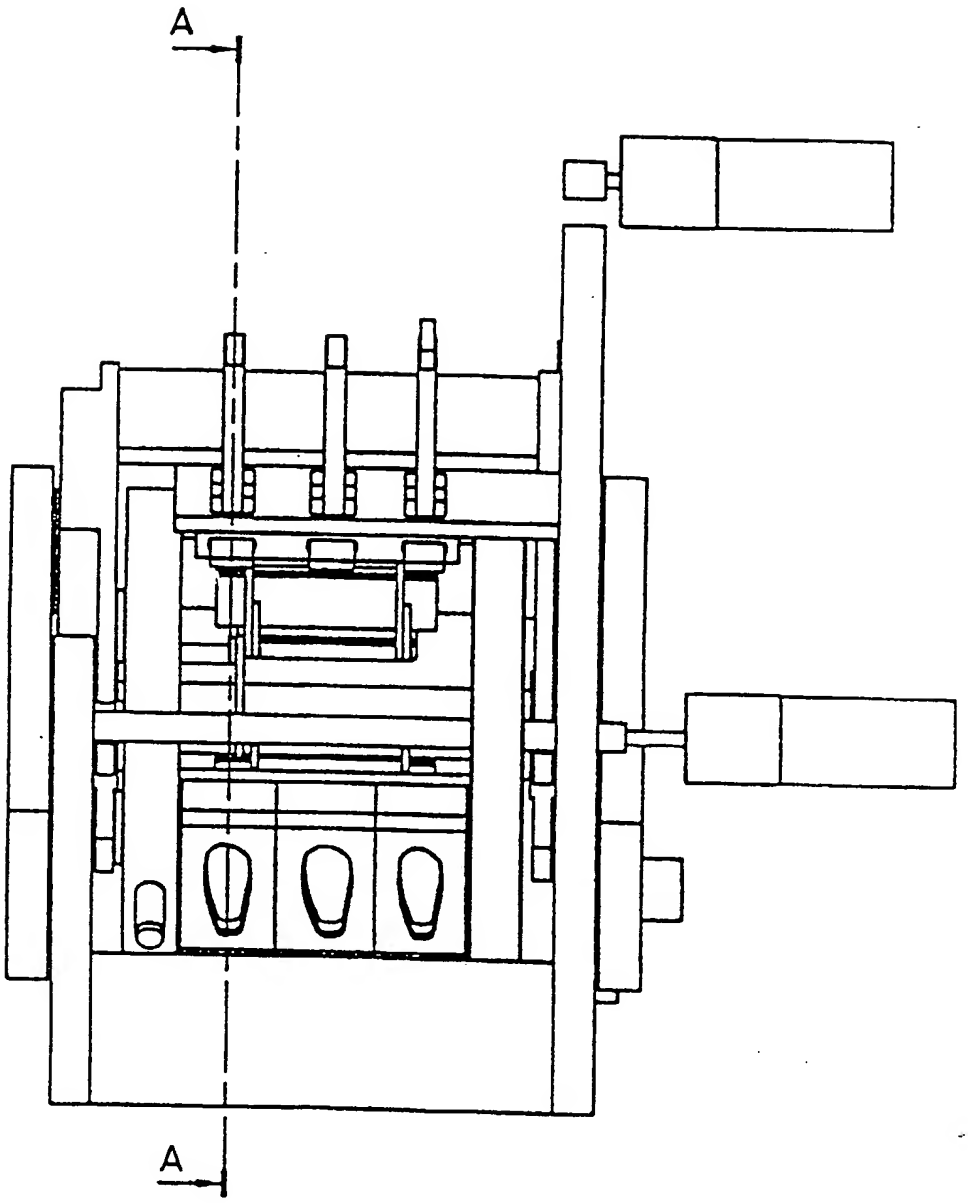
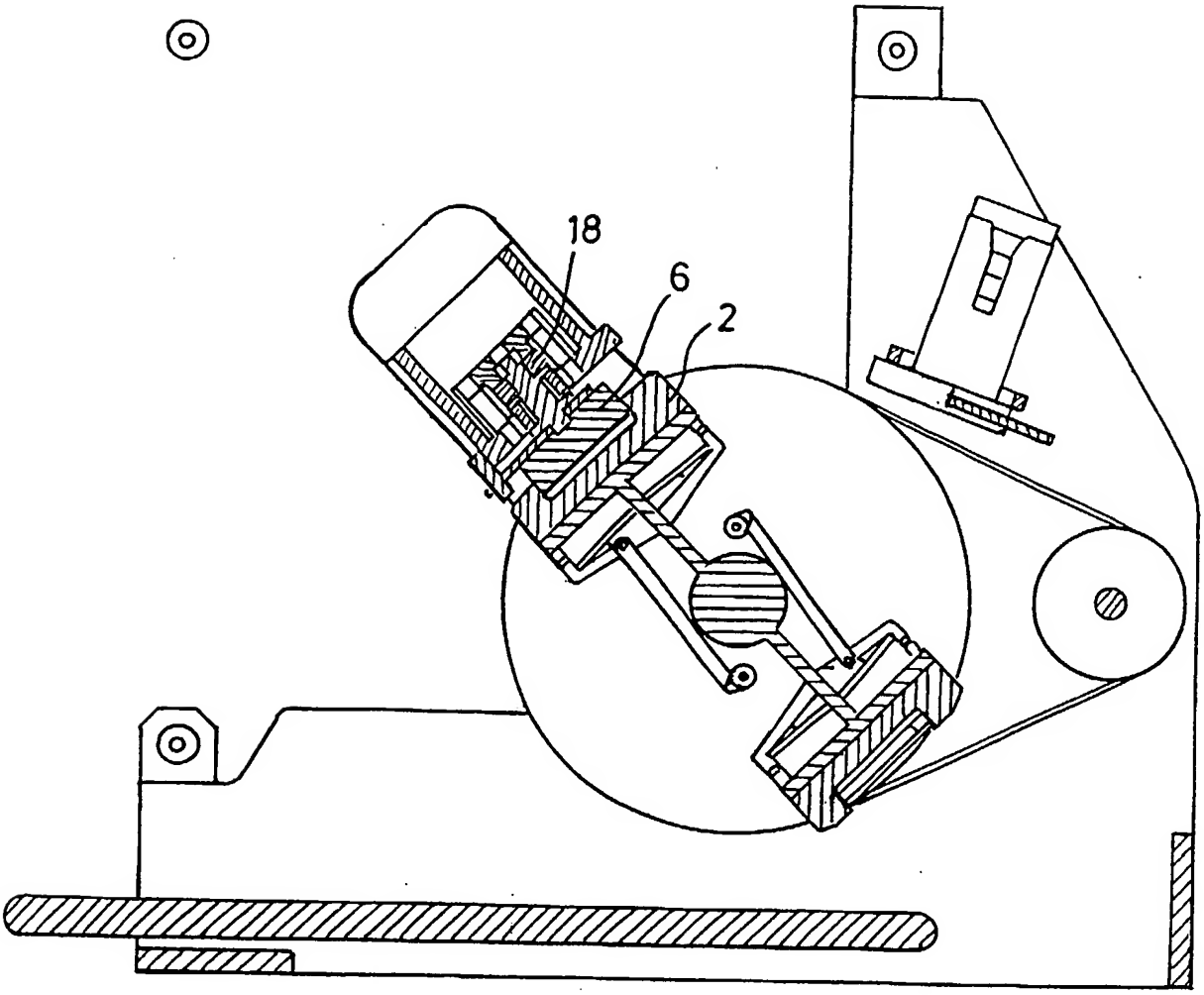


Fig. 17



A-A

Fig. 18

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Title: Apparatus for shaping blocks of material

Field of invention

This invention concerns the shaping of blocks of material, typically but not exclusively blocks of frozen foodstuff.

Background to the invention

It has been proposed to shape rectilinearly shaped blocks of frozen foodstuff by locating each block in a cavity, the internal shape of which will dictate the eventual shape of at least part of the surface of the block after shaping, and forcing the block into the cavity under hydraulic pressure. The material flows and assumes a new shape dictated by the shape of the cavity and the shape of the article forcing the material into the cavity, whilst the material remains frozen.

It is an object of the present invention to provide improved apparatus for performing the shaping process, whereby the process can be speeded up.

Summary of the invention

Apparatus for shaping blocks of formable material and embodying the invention comprises a rotatable drum carrying at least two outwardly facing cavities therearound, means for rotating the drum from a loading position to a discharge position, a magazine at the loading position containing a plurality of blocks of material in a stack, each of which is to be shaped under pressure after being located in one of the cavities, means for displacing a

block from one end of the stack into one of the cavities as it registers with the magazine as the drum rotates, collection means remote from the magazine at the discharge position into which shaped blocks are transferred after the drum has rotated through an appropriate angular distance, and means for forcing a block into a cavity to shape the material as the drum rotates between the loading position and the discharge position.

The cavities may be located at diametrically opposite points around the drum.

Likewise the loading and discharge positions may be located at diametrically opposite points around the drum.

The axial width of the drum may be such as to accommodate at each location a plurality of cavities in line, and a corresponding number of magazines and collection means are provided across the width of the drum.

Typically the force required to compress the material into the or each cavity is derived from a linkage carrying a thrust member adapted to enter and compress material into the or each cavity.

In such an arrangement part of the linkage may be fixed in relation to the axis of rotation of the drum and be positioned relative thereto so that as a cavity containing a block of material to be shaped begins to register with the thrust member, with rotation of the drum relative movement between the linkage and the drum causes the thrust member to be moved into and out of the cavity.

Rotation of the drum causes the linkage to move through a top dead centre position and conveniently the thrust member is forced fully into the cavity at the top dead centre and is thereafter withdrawn therefrom.

Preferably upon engagement of the thrust member with a cavity, the thrust member rotates with the drum until it withdraws completely from the cavity.

Conveyor means may be provided adapted to remove blocks which have left the drum.

Discharge may be effected by rotating the drum until the shaped blocks fall out of the cavities.

Preferably ejector means is provided to positively push the shaped blocks from the cavities.

The ejector means may comprise a plunger, and may be operated in response to rotation of the drum.

Apparatus embodying the invention is of particular use in shaping blocks of frozen foodstuff.

Typically for such an application the apparatus is situated in an enclosure wherein means is provided to control the environment within the enclosure to maintain a temperature therein such as to prevent frozen foodstuff portions in the apparatus from thawing.

Apparatus embodying the invention preferably further comprises a programmable drum drive, whereby the speed of drum rotation is altered during each rotation so as to be different at different points around each rotation of the drum.

Typically the drum drive is a computer controlled servo drive.

Preferably the instantaneous drum speed is altered during the shaping step.

The apparatus may further comprise means for spraying a fluid on the blocks just before or as they enter a cavity, or for spraying a fluid into each cavity just prior to the insertion of a block therein, or for spraying a fluid onto the thrust member which enters the cavity to shape the product during the drum rotation.

Typically the fluid is sprayed in the form of a fine mist.

Preferably the spray means operates to spray each cavity as it travels from the unloading or discharge station to the loading station, so as to rinse or coat each cavity after a shaped block has been ejected.

The fluid may be water, or a fluid having a sticky consistency may be employed which will coat the interior of each cavity before the next block of product is inserted.

The invention also lies in a method of shaping blocks of formable material comprising the steps of removing blocks one at a time from a stack at a loading position in synchronism with the rotation of a drum containing at least two shaping cavities in its cylindrical surface, one block being removed as each cavity registers with the stack, means for receiving shaped blocks from cavities at an unloading position after the blocks have been formed to shape therein under pressure and the drum has rotated so that a cavity has moved from the loading to the unloading position, wherein during the rotation of the drum between those two positions the block of material is forced into the cavity by a thrust member so as to change the shape of the block of material to that determined by the cavity and the thrust member.

The method may include the step of monitoring the temperature of the blocks.

The method may also include the step of controlling the temperature of the blocks before and after shaping so as to maintain the blocks of material at a temperature below zero °C.

The method preferably includes the step of ejecting shaped portion from the cavities as they approach the unloading position.

The method may also involve the step of synchronously moving a thrust member into a cavity as the drum rotates.

Preferably the method further comprises the step of altering the speed of rotation of the drum during rotation thereof.

Typically the drum speed is altered during the shaping step.

The method is readily effected where the drum is rotated by a computer controlled servo drive and the computer is programmed to adjust the speed of rotation of the drum, as required.

Preferably the method further comprises the step of spraying a fluid onto the blocks just before or as they enter a cavity.

In addition or instead the method may comprise the step of spraying a fluid into each cavity just prior to the insertion of a block therein.

In addition or instead the method may comprise the step of spraying a fluid onto the thrust member which is to enter the cavity.

The fluid is preferably sprayed in the form of a fine mist.

Preferably the method involves the step of spraying fluid into a cavity as it travels from the unloading station to the loading station.

Typically the method involves the use of water as the fluid.

In addition or instead of water, a fluid may be used which has a sticky consistency and the method involves coating the interior of the cavity with this material before the next block of product is inserted therein.

The method may be employed in forming blocks of foodstuff.

The invention will now be described by way of example, with reference to the accompanying drawings, in which:

Sequence diagram I shows the principle of shaping embodied in the apparatus shown in later Figures, in which the thrust member which is to enter the cavity and achieve the shaping is carried by the drum,

Sequence diagram II shows an alternative arrangement in which the thrust member which is to enter the cavity is mounted externally of the drum,

Figures 13 to 18 are different views of apparatus constructed to perform a sequence similar to that shown in sequence diagram I.

In the drawings

Sequence diagram I shows various stages of rotation of a drum (1) from 0° to 180°. At this point the sequence is repeated.

The sequence shows the following stages with approximate drum rotation angles:

Figure 1 – Cavity(s) at top about to receive its charge from the magazine, those at the bottom about to eject shaped portions.

Figure 2 – Drum moving under frame (7) containing plunger(s) (6).

Figure 3 – Drum in position under plunger(s), frame (7) being accelerated up to drum speed. Portion ejected from lower cavity(s) onto discharge conveyor.

Figure 4 – Frame (7) and drum rotating together, pin engaged in bush, plunger engaged in cavity.

Figure 5 – Link (8) pulling frame (7) and plunger(s) in their cavity(s) shaping the product.

Figure 6 – Max product compression, plunger hydraulic cylinder (spring) displaced at almost constant force.

Figure 7 – Plunger starts to lift out of cavity.

Figure 8 – Plunger lifts further.

Figure 9 – Plunger completely out, pin disengaged from bush, frame (7) shopped and about to return to original position.

Figure 10 – Frame (7) returning to original position.

Figure 11 – As in 10.

Figure 12 – Drum rotated 180°, frame (7) back to original position.

The later views in Figures 13 to 18 show a practical embodiment of the machine, the example shown is by no means the only method of achieving the same result.

Referring to the later Figures, the mode of operation of the machine is as follows:

The machine is for shaping frozen or solid food from a blank, usually rectilinear in shape, to a form determined by the shape of a machined cavity or tool (2). The cavities are precision mounted on a drum (1). A number of such cavities can be bolted side by side across the drum and an equal number bolted at a diametrically opposite position around the drum.

The cavities incorporate ejector pins which when activated, typically as a result of the drum rotation and position, push the shaped product out of the cavity at an appropriate position of the drum such that the shaped portion drops onto a discharge conveyor (16). The various elements of the mechanism used to drive the ejectors are indicated at (17).

The cavities are fed with blanks (3) from a magazine(s) (4). The feed device may be a simple extension to the drum such that the blank(s) at the bottom of the stack are drawn off by the drum rotation. Alternatively the blanks may be moved by a separate actuator (5), eg a pusher driven by a pneumatic cylinder, timed such that the blank drops into the cavity as it passes underneath (see Figure 2).

The blank is shaped by introducing a plunger (6) into the cavity and by forcing the plunger into the cavity to a point where the blank adopts the enclosed shape of the plunger and cavity. The plunger is a close fit within the cavity to prevent product leakage when compressed,.

The plunger is introduced into the cavity while the drum is rotating, by being mounted to a reciprocating frame(7). This frame is in turn coupled to the drum centre shaft such that it can slide radially in and out of the cavity, but not rotate relative to the cavity while so doing. This frame is also controlled radially by a pair of links (8) anchored to the base (9) and to the frame (7). The geometry of this linkage in relation to the drum is such that once the plunger (6) is engaged in the cavity, and the frame (7) is thus rotating with the drum, the link draws the frame and thus the plunger, towards the drum centre until a point is reached where the centre line of the links passes through the drum centre line (see Figure 6). At this point, the volume enclosed within the cavity and the plunger is at a minimum.

Further drum rotation enables the plunger and frame to move away from the drum until the plunger is completely out of the cavity (see Figure 9).

The frame (7) is then synchronously returned to its original position so as to register with the other cavity(s) on the drum, which are position 180° from the first cavity(s).

This reciprocating action of the frame (7) through an angle of approximately 90°, is controlled by a servomotor (10) driving a belt (11) which in turn is clamped to the frame (7) and (12). The drive belt loop is completed by an idler (13) and a tensioner (14), both mounted on the base frame.

The drum is rotated by a servomotor (20), or motor with encoder, such that the correct synchronisation between the constantly rotating drum and the reciprocating frame (7) can be achieved.

Flywheels (15) are attached to the drum so that speed variation due to load fluctuations during the cycle, is kept to a minimum.

To avoid overloading the linkage at top dead centre (see Figure 6), the plunger (6) is spring mounted (with preload) onto the frame (7). This is typically achieved by hydraulic cylinder (18) connected in a closed circuit with an accumulator. This is pressurised to such a degree that to compress the plunger (and hence the cylinder), off its stop requires a force equal to, or slightly in excess of, the force necessary to shape the portion.

It is important that lateral force is not transmitted between the plunger and the cavity wall. To this end an aligning pin (19) and bush combination is used between the drum and the frame (7). The pin is fixed to the drum and the bush is mounted on the frame such that as the frame is initially synchronised with the drum the relative radial motion between the two introduces the pin (19) into the bush (the pin having a chamfered lead-in) and ensures precise alignment between plunger and cavity.

Additionally the plunger (6) may be mounted loosely on its frame so that is able to slide laterally in any direction on its mount to self centre and therefore accommodate manufacturing tolerances.

An alternative arrangement (not shown) involves a 3 part assembly, ie a cavity as previously described (but shallower such that it only contains say 80% of the final portion volume), a plunger as previously described, and an outer tool surrounding the plunger, free to move relative to the plunger, and sprung loaded. The outer tool is arranged to abut the face of the cavity and the plunger is arranged to move within the outer tool to perform the compression as before, but with the outer tool containing some of the portion as it is compressed. This arrangement avoids the need for the plunger to be aligned with and enter the cavity with the associated potential wear problems, but adds complexity and impact noise.

There are other ways of achieving the required plunger motion such as shown in Sequence Diagram II, although this would not result in exactly the same motion as the first described method, but could be acceptable.

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Claims

1. Apparatus for shaping blocks of formable material comprising a rotatable drum carrying at least two outwardly facing cavities therearound, means for rotating the drum from a loading position to a discharge position, a magazine at the loading position containing a plurality of blocks of material in a stack, each of which is to be shaped under pressure after being located in one of the cavities, means for displacing a block from one end of the stack into one of the cavities as it registers with the magazine as the drum rotates, collection means remote from the magazine at the discharge position into which shaped blocks are transferred after the drum has rotated through an appropriate angular distance, and means for forcing a block into a cavity to shape the material as the drum rotates between the loading position and the discharge position.

2. Apparatus as claimed in claim 1 wherein the cavities are located at diametrically opposite points around the drum.

3. Apparatus as claimed in claim 1 or 2 wherein the loading and discharge positions are located at diametrically opposite points around the drum.

4. Apparatus as claimed in any of claims 1 to 3 wherein the axial width of the drum is such as to accommodate at each location a plurality of cavities in line, and a corresponding number of magazines and collection means are provided across the width of the drum.

5. Apparatus as claimed in any of claims 1 to 4 wherein the force required to compress the material into the or each cavity is derived from a linkage carrying a thrust member adapted to enter and compress material into the or each cavity.

6. Apparatus as claimed in claim 5 wherein part of the linkage is fixed in relation to the axis of rotation of the drum and is positioned relative thereto so that as a cavity containing

a block of material to be shaped begins to register with the thrust member, with rotation of the drum relative movement between the linkage and the drum causes the thrust member to be moved into and out of the cavity.

7. Apparatus as claimed in claim 6 wherein rotation of the drum causes the linkage to move through a top dead centre position and the thrust member is forced fully into the cavity at the top dead centre and is thereafter withdrawn therefrom.

8. Apparatus as claimed in any of claims 5 to 7 wherein upon engagement of the thrust member with the cavity the thrust member rotates with the drum until it withdraws completely from the cavity.

9. Apparatus as claimed in any of claims 1 to 8 further comprising conveyor means adapted to remove blocks which have left the drum.

10. Apparatus as claimed in any of claims 1 to 9 wherein discharge is effected by rotating the drum until the shaped blocks fall out of the cavities.

11. Apparatus as claimed in any of claims 1 to 9 wherein ejector means is provided to positively push the shaped blocks from the cavities.

12. Apparatus as claimed in claim 11 wherein the ejector means comprises a plunger.

13. Apparatus as claimed in claim 11 or 12 wherein the ejector means is operated in response to rotation of the drum.

14. Apparatus as claimed in any of claims 1 to 13 for shaping blocks of frozen foodstuff, when situated in an enclosure wherein means is provided to control the environment within the enclosure to maintain a temperature therein such as to prevent frozen foodstuff portions in the apparatus from thawing.

15. Apparatus as claimed in any of claims 1 to 14 further comprising a programmable drum drive, whereby the speed of drum rotation is altered during each rotation so as to be different at different points around each rotation of the drum.

16. Apparatus as claimed in claim 15 wherein the instantaneous drum speed is altered during the shaping step.

17. Apparatus as claimed in claim 15 or 16 wherein the drum drive is a computer controlled servo drive.

18. Apparatus as claimed in any of claims 1 to 17 further comprising means for spraying a fluid on the blocks just before or as they enter a cavity.

19. Apparatus as claimed in any of claims 1 to 18 further comprising means for spraying a fluid into each cavity just prior to the insertion of a block therein.

20. Apparatus as claimed in any of claims 1 to 19 further comprising means for spraying a fluid onto the thrust member which enters the cavity to shape the product during the drum rotation.

21. Apparatus as claimed in any of claims 18 to 20 wherein the fluid is sprayed in the form of a fine mist.

22. Apparatus as claimed in claim 19 or 20 wherein the spray means operates to spray each cavity as it travels from the unloading or discharge station to the loading station.

23. Apparatus as claimed in any of claims 18 to 22 wherein the fluid is water.

24. Apparatus as claimed in claim 22 wherein he fluid has a sticky consistency so that it will coat the interior of the cavity before the next block of product is inserted.

25. A method of shaping blocks of formable material comprising the steps of removing blocks one at a time from a stack at a loading position in synchronism with the rotation of a drum containing at least two shaping cavities in its cylindrical surface, one block being removed as each cavity registers with the stack, means for receiving shaped blocks from cavities at an unloading position after the blocks have been formed to shape therein under pressure and the drum has rotated so that a cavity has moved from the loading to the unloading position, wherein during the rotation of the drum between those two positions the block of material is forced into the cavity by a thrust member so as to change the shape of the block of material to that determined by the cavity and the thrust member.

26. A method as claimed in claim 25 further comprising the step of monitoring the temperature of the blocks.

27. A method as claimed in claim 25 or 26 further comprising the step of controlling the temperature of the blocks before and after shaping so as to maintain the blocks of material at a temperature below zero °C.

28. A method as claimed in claim 25, 26 or 27 further comprising the step of ejecting shaped portion from the cavities as they approach the unloading position.

29. A method as claimed in any of claims 25 to 28 further comprising the step of synchronously moving a thrust member into a cavity as the drum rotates.

30. A method as claimed in any of claims 25 to 29 further comprising the step of altering the speed of rotation of the drum during rotation thereof.

31. A method as claimed in claim 30 wherein the drum speed is altered during the shaping step.

32. A method as claimed in claim 30 or 31 wherein the drum is rotated by a computer controlled servo drive and the computer is programmed to adjust the speed of rotation of the drum.

33. A method as claimed in any of claims 25 to 32 further comprising the step of spraying a fluid onto the blocks just before or as they enter a cavity.

34. A method as claimed in any of claims 25 to 33 further comprising the step of spraying a fluid into each cavity just prior to the insertion of a block therein.

35. A method as claimed in any of claims 25 to 34 further comprising the step of spraying a fluid onto the thrust member which is to enter the cavity.

36. A method as claimed in any of claims 33 to 35 wherein the fluid is sprayed in the form of a fine mist.

37. A method as claimed in any of claims 33 to 36 further comprising the step of spraying fluid into a cavity as it travels from the unloading station to the loading station.

38. A method as claimed in any of claims 33 to 37 wherein the fluid is water.

39. A method as claimed in claim 37 wherein the fluid has a sticky consistency and the method involves coating the interior of the cavity with the fluid before the next block of product is inserted therein.

40. A method as claimed in any of claims 25 to 39 wherein the formable material is a foodstuff.

41. Apparatus for shaping blocks of formable material constructed arranged and adapted to operate substantially as herein described or with reference to the accompanying drawings.

42. A method for shaping blocks of formable material substantially as herein described or with reference to the accompanying drawings.

Application No: GB 0213084.7 **Examiner:** Monty Siddique
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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T): B5A (AA2, AA3, AF36C, AF36X, AF39C, AF39G, AF39X, AF40X, AT1P)

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Other: Online: WPI EPODOC JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2280869 A	(WHITEHOUSE) entire document and particularly page 5 and line 23 to page 6 and line 4	1, 9, 10, 11, 25, 28 at least
Y	WO 1993/000817	(KONIG) see drawing	1, 2, 3 at least
Y	FR 2538223 A1	(TIFFON) a magazine at the loading station with a stack of blocks to be divided	1, 2, 3 at least
Y	DE 3217159 A	(NIENSTEDT) see drawing and abstract	1, 2, 3 at least
Y	US 5158785	(KONIG) see drawing, pressing in member 15 etc.	1, 2, 3 at least
A	US 3829262	(AQUARIUS)	
A	US 3683793	(MAHOGANY) slice packed in rotating pockets	1, 2, 3 at least

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